AIR REGISTRATION BOARD

INSPECTION AND DESIGN APPROVAL OF FIRMS

UNDER THE

AIR NAVIGATION ORDER

A.R.B. HANDBOOK No. 3

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NOTE

THE PURPOSE of this handbook is to explain the principles of Approval as applied to the inspection and design organisations of firms engaged in the Civil Aircraft Industry, and to indicate the general lines on which an effective organisation can be set up and operated.

These principles have been adopted as a result of experience and, although the procedure as described may appear to be involved, it is in fact not dissimilar to that adopted by many firms on their own initiative as the minimum necessary to achieve consistency of quality.

Certain fundamental features of procedure have been prescribed, but detailed methods of operation have not been laid down as these may be varied to meet particular circumstances and will be acceptable so long as the principles of approved inspection and design are upheld.

CONTENTS

		Page
I	General	5
II	General Requirements for Inspection Approval	6
III	Application for and Manner of Granting Inspection Approval	11
IV	Operation of Inspection Approval	12
V	General Requirements for Design Approval	16
VI	Application for and Manner of Granting Design Approval	18
VII	Operation of Design Approval	20

I

GENERAL

CERTIFICATES of Airworthiness are issued by the Minister of Transport and Civil Aviation, on the recommendation of the Air Registration Board. Before making such recommendations, the Board must, in the case of a new aircraft, be satisfied that the design, material and standards of construction are as laid down in its requirements and, in the case of repairs to aircraft, that the same conditions apply as to material, and that the work has been properly carried out in accordance with the requirements of the Board.

The Board could satisfy itself as to these matters by appointing officers to scrutinise the manufacture of materials and the various parts and finally the complete aircraft or engine, but this would clearly be impracticable. The principle was laid down many years ago, that in the case of certain responsible firms, the certificate of the manufacturer or constructor could be accepted in lieu of detailed inspection by the regulating authority. This is, in fact, a brief definition of the word "approval" when used in connection with the construction or repair of aircraft or aircraft equipment.

The Minister of Transport and Civil Aviation has taken powers to approve certain firms for the purpose of furnishing reports to him in this way, and he has delegated this power of approval to the Air Registration Board.

It is an essential condition in the construction of an aircraft which is to hold a Certificate of Airworthiness, that there should be some guarantee that the material from which the aircraft and its equipment are constructed shall conform to the requirements laid down by the designer and approved by the Board. It would not be difficult to ensure this in the case of one aircraft or item of equipment but, when a number of aircraft are built to the same design, steps must be taken to satisfy the Board that the quality of the material and workmanship are consistent and that the standards which were approved for the original are fully maintained.

The majority of firms manufacturing material or aircraft have a system of inspection designed to satisfy this requirement and, in broad terms, if this system is effective, as explained hereafter, the firm can be approved and its certificate accepted in respect of aircraft or parts to be used in the construction of aircraft.

Firms may be approved in respect of one or more activities, as for instance, the manufacture of material, the conversion of that material into aircraft parts, or the construction of a complete aircraft or complete aircraft engine.

The same general principles apply to the organisation of the firms engaged in the design of civil aircraft. While the published requirements of the Board must be met, the firm's certificate that the requirements have been met is acceptable if the design organisation has been approved by the Board.

Inspection approval is dealt with in Sections II to IV and design approval in Sections V to VII of this Handbook.

A register is published annually by the Board giving brief particulars of approved firms and the nature of the work for which approval has been granted.

II

GENERAL REQUIREMENTS FOR INSPECTION APPROVAL

CERTAIN general requirements must be met by a firm seeking approval of its inspection organisation, in respect of the following matters:—

(a) Inspection staff
(b) Accommodation and equipment
(c) Inspection procedure
(d) Inspection stamps
(e) Quarantine and Bonded Stores
(f) Inspection records

(a) Inspection Staff

The inspection organisation and staff must be controlled by a Chief Inspector who must be directly responsible to the Directors of the firm so that his decisions are not influenced by considerations other than the quality of the work for which he is responsible. It is also essential that the Chief Inspector should control inspection through all departments of the firm. If such an arrangement is not possible, by reason of the fact that certain departments are engaged on specialised work, these departments must then operate under a separate approval authority. The same procedure will apply in the case of associate or branch works of a main organisation when the control of inspection is divided.

The Chief Inspector, being directly responsible for the satisfactory operation of the approval and for the inspection staff, is in a key position so far as the Board's approval of the organisation is concerned. Before approval is granted, the qualifications of the Chief Inspector are examined by the Board and, if he subsequently ceases to hold the position of Chief Inspector, the appointment of a successor must be similarly agreed by the Board.

The Chief Inspector must be thoroughly conversant with the Board's requirements particularly relating to approval and should also have a good knowledge of the inspection requirements of the Board so far as they affect the particular product or work for which he is responsible. In cases of firms undertaking construction, repair or overhaul, the Board may require that the Chief Inspector should hold an Aircraft Engineer's Licence in the appropriate category.

The total number of the inspection staff will vary with the volume and nature of the work undertaken by the firm and may, in the case of a small firm, consist of one individual only, but it is important to note that the Board must be informed of any substantial change in the inspection staff.

(b) Accommodation and Equipment

The inspection staff must be provided with suitable accommodation and such equipment as may be necessary to enable them to carry out the inspection of the firm's products to the Board's requirements. The extent of the accommodation will depend on the nature of the work involved and the extent to which special jigs, tools, etc., are required.

In order that the Board's Surveyor may undertake the duties assigned to him under the terms of approval, suitable office accommodation should be made available to him in the works of firms undertaking construction or repair and overhaul of aircraft or aircraft engines.

In addition to the accommodation required for purely inspectional purposes, the conditions of the approval require that the general lay-out and arrangement of workshops are such as will enable the inspection organisation to fulfil its responsibilities in an efficient and effective manner. This latter condition particularly applies to firms undertaking repair and overhaul work.

(c) Inspection Procedure

Inspection procedure is described later in general terms, under the heading of "Operation of Approval", but it is important to note the Board's requirements in respect of the following:—

(i) Approved Certificates. Approved Certificates are issued to cover the release of goods from an approved organisation and the distribution must be as under:—

(a) Copy to consignee.

(b) Copies for consignor's records as required.

Approved Certificates must be pre-numbered serially and issued consecutively.

If a Certificate is raised and subsequently cancelled, the copies must be clearly marked in such a way as to indicate the cancellation. One cancelled copy should be retained in the firm's records.

(ii) Concessions. Concessions may be granted to use a limited quantity of material, details or parts which have been incorrectly manufactured but are not unserviceable. Such concessions may be granted by the constructor's approved inspection staff subject to certain limitations and conditions which are briefly as follows:—

(a) Each concession must be recorded on a form to be agreed by the Board and must be numbered serially.

(b) Particulars and quantities of the material or parts affected by the concession must be clearly recorded.

(c) Where practicable, parts affected must be suitably marked.

(d) Concessions cannot be considered for parts where strength or functioning is affected.

(d) Inspection Stamps

The products of an approved firm must, before their incorporation in an aircraft or aircraft engine, or issue to another firm, bear the impression of an inspection stamp as evidence of their correctness.

The design of such stamps must be submitted to the Board and agreed before the approval is granted. They normally take the form of a border containing the initials of the firm's title together with a number which will identify the individual inspector.

Metal and/or rubber stamps, in suitable sizes, must be provided and in the case of the metal stamp it is important that the border should be of a design in which sharp corners are avoided.

(a) Metal stamps should be used only for metallic parts which are not liable to damage thereby.

(b) Rubber stamps should be used for metallic parts which might be damaged by the impression of a metal stamp, e.g. parts constructed of tubing or strip. For the same reason, rubber stamps are generally used on non-metallic materials.

(c) When the parts are too small for individual marking and are bundled, the stamp may be impressed on the metal tab or label which seals the bundle.

As inspection stamps are intended, *inter alia*, to identify individual inspectors' responsibility, they must not be transferred from one inspector to another, unless they have been quarantined for a minimum period of six months.

(e) Quarantine and Bonded Stores

The provision of suitable stores accommodation is an essential part of the inspection facilities of an approved firm. A "Quarantine" store must be provided in which material or parts awaiting inspection, or evidence of prior inspection, can be kept.

When such evidence is available, the goods must be transferred to a "Bonded" store. This store is used for the reception of "fully released" materials and parts and for finished parts passed by the firm's own inspection staff. It can also be used for the storage of reconditioned parts, provided that evidence of condition is suitably indicated.

This Bonded store must be of such dimensions and so arranged that all materials and parts can be segregated and readily identified.

Except in special circumstances, it is essential for the Quarantine and Bonded stores to be reserved for aircraft materials and for the general commercial stores to be separately housed.

The responsibility for the proper use and arrangement of the stores rests with the Chief Inspector.

(f) Inspection Records

It is a condition of approval that the inspection organisation of an approved firm shall maintain adequate inspection records. Two main purposes are intended to be served by these. The first is to enable parts to be traced back through all manufacturing processes to the raw material so that, in the event of a part being found to be below the required standard of safety, then the other parts from the "parent" batch or billet, as the case may be, can be located.

The second purpose follows on the first. If faulty parts or material are found, records of the results of the appropriate check tests must be available as evidence that the items in question have been manufactured in accordance with the conditions prescribed by the Board.

In addition to the inspection records of manufacturing processes, check tests, etc., which must be kept in accordance with the requirements of the Board, approved firms engaged on the construction or repair of aircraft or engines are required, under the Air Navigation Acts, to complete certain documents as follows:—

Particulars of the inspection carried out on the installations and at the final stages of assembly of an aircraft or engine shall be entered in a Civil Aircraft Inspection Record (A.R.B. Form 268), copies of which are supplied by the Board.

Standard log books must also be raised for every newly constructed aircraft and engine, and it is the responsibility of the Chief Inspector to ensure that the appropriate data are correctly entered.

When in the course of overhaul it is required to replace, repair or modify any part of an aircraft or engine, a comprehensive description of the work carried out must be recorded in the appropriate log book. The entries must also include Approved Certificate numbers, serial numbers of replaced components, approved repair scheme or modification references, as may be appropriate.

Where the work is carried out by an approved firm, the log book entries must be certified by the Chief Inspector or other representative of the firm authorised for the purpose, or by a suitably licensed engineer.

III

APPLICATION FOR AND MANNER OF GRANTING INSPECTION APPROVAL

A FIRM requiring approval should apply in the first instance to the Secretary, Air Registration Board, Chancery House, Chancery Lane, W.C.2, for the official form of application which, when completed, should be forwarded to the above address. An arrangement will then be made for the Board's Surveyor to visit the firm to investigate and report on the inspection organisation, personnel, etc.

It should be noted that, under the provisions of the Air Navigation Order 1954, a statutory fee of £10 per annum is payable in respect of each approved organisation of a firm. Details of this fee are given in Schedule III of the Air Navigation Order 1954.

On the official form of application, the applicant will be required to state the nature of the work for which inspection approval is being sought. It will be the duty of the Board's Surveyor, in the course of his visit, to satisfy himself that the inspection organisation personnel and workshop facilities, etc., at the disposal of the applicant, are such as will permit the firm to execute the specified class of work in accordance with the requirements of the Board. If necessary, the Board's Surveyor will offer advice or information in respect of any matters which in his opinion require alteration or improvement before approval can be recommended. In such circumstances it may be considered desirable to arrange for a further visit at a later date.

Subject to the inspection organisation being considered satisfactory, the Board's Surveyor will advise the firm how to prepare a draft of an Approved Certificate and will also allot an approval authority number. A printer's proof copy of the Approved Certificate must then be submitted to the Board for approval.

At the same time as the proof is submitted, a facsimile of the inspector's stamp which it is proposed to use should be forwarded for approval and for record purposes, unless other suitable arrangements have been made with the Board's Surveyor.

At the earliest opportunity the recommendation of the Surveyor is submitted to the Council of the Board for ratification. If the

approval is granted, the Board will send a formal letter to the firm authorising the approval which will normally take effect from the date of the letter. A schedule of the terms of approval specifying precisely the nature of the work which the firm is authorised to certify by virtue of the approval granted, will be sent with the formal letter of approval. A Certificate of Approval will also be sent to the firm in due course.

In the event of a firm wishing to increase the scope of its activities outside the authority of an existing approval, the Board may, subject to being satisfied that the new work can be carried out in accordance with the Board's requirements, extend the firm's approval in appropriate terms.

IV

OPERATION OF INSPECTION APPROVAL

THE ACTIVITIES of the Aircraft Industry are of such number and variety that it is impracticable, within the scope of this handbook, to give more than a general outline of the manner in which an approved inspection organisation must operate. For full details of the prescribed requirements, reference should be made to British Civil Airworthiness Requirements.

Broadly, the Aircraft Industry can be divided into the following main functional groups:—

(a) Constructors of aircraft or aircraft engines.

(b) Repair organisations dealing with complete aircraft, engines, instruments, or component parts thereof.

(c) Manufacturers of component parts.

(d) Manufacturers of instruments, equipment or accessories.

(e) Firms engaged in specialised processes, e.g. protective treatments, mechanical tests, chemical analysis or radiological examination.

(f) Manufacturers of aircraft materials.

Individual firms comprising these main groups will normally operate an inspection organisation approved by the Board. The effect of the Board granting such approval is to make these firms responsible, through their Chief Inspector, for ensuring that the procedure of manufacture, repair or processing, is carried out in accordance with the prescribed requirements, and to enable these firms to issue a certificate to that effect.

In the operation of this approval four distinct responsibilities devolve on the inspection organisation, namely:—

(1) To ensure that all materials used in the manufacture of aircraft conform to the approved specifications.

(2) To ensure that all parts or components conform to the latest issue of approved drawings and specifications.

(3) To ensure that all manufacturing processes and prescribed inspection tests are carried out in accordance with the requirements of the Board.

(4) To ensure by means of an adequate and accurate system of records that all parts and materials can be identified and traced to origin at any stage of manufacture.

The general procedure which must be adopted in order to ensure that these particular requirements can be met, is as follows:—

In the first instance an approved firm issues the raw material which may be in the form of a billet, bar or metal strip, certifying it as being in accordance with a particular specification as proved by mechanical tests or chemical analysis. These tests are carried out in the firm's own approved laboratories or, if such are not included in the organisation, in the laboratories of some firm approved for such purposes. In all cases accurate records of mechanical and chemical tests must be suitably correlated to the appropriate batches of material.

Material so released is acceptable to a firm who may wish to undertake the conversion to forgings, castings, sheets, etc. Immediately on receipt of material at a processing firm, the inspection organisation of that firm ascertains if the consignment is accompanied by

the Approved Certificate of the supplier. Should this not be the case, the material is held in a Quarantine Store to await identification. When the Approved Certificate is available, the material is placed in the Bonded Store, access to which must be under the control of the Chief Inspector. Here the material is conveniently batched and numbered in such a way as to correlate with the relative incoming Approved Certificate. If required the batch number can be the actual Certificate number, and for convenience, other particulars such as the specification number of the material can be included on the tally card.

Upon issue to the shops for processing, a card is raised which must include the batch number. It may also be desirable to show specification and drawing numbers. This card follows the batch through all stages of manufacture and is finally filed by the inspection department with the number of the outgoing Approved Certificate duly entered. A convenient method is to make the job card fulfil this function, and a continuous record of all material or parts is thus maintained.

Throughout the course of work the inspection department must satisfy itself that all processes are executed in the prescribed manner and finally that the finished articles conform to the approved drawings, and that all articles bear the appropriate inspection stamp.

Upon completion of manufacture and before despatch, the Chief Inspector, or his authorised deputy, signs the Approved Certificate which is issued in respect of each batch of parts or material for delivery, and which should accompany the goods to the consignee.

The parts may now go through any of a variety of processes, e.g. protective treatment, machining, or they may be converted into component parts before finally reaching the constructing firm where they will be built into instruments, engines, or complete aircraft.

The system of inspection and method of maintaining records at every firm handling the parts is, however, basically the same as described above, although some variation and amplification may be introduced to conform to the general organisation of individual firms or to specialised methods of manufacture. The correlation of the records of each firm relative to particular parts, is achieved by the issue of the Approved Certificate to cover the release of the goods from one firm to another.

It is obvious that the greater the scope of an individual firm's activities, the more essential efficient inspection becomes and the greater are the responsibilities which have to be assumed by the Chief Inspector.

In the case of the aircraft or engine constructor, the Chief Inspector, in addition to controlling the inspection organisation and maintaining all records which may cover a wide variety of manufacturing processes, treatments and inspection tests, etc., is required to complete and submit to the Board's supervising Surveyor, the necessary documents required to enable him to recommend the issue of a Certificate of Airworthiness in the case of an aircraft, or a Certificate of Acceptance for an aircraft engine. This same responsibility rests with the Chief Inspector of a firm undertaking the repair and overhaul of aircraft for the renewal of Certificates of Airworthiness.

Where an approved firm is engaged on the construction of prototype aircraft or aircraft engines, the Board may require that its Surveyors carry out a final inspection of the complete aircraft or engine and of all complete components, in addition to the inspections carried out by the firm. The Chief Inspector is responsible for advising the Board's supervising Surveyor of the progress of work so that mutually convenient arrangements can be made for him to carry out his inspections. The inspection organisation of the firm is, however, solely responsible for the inspection during all intermediate stages of manufacture and construction.

Supervision of Inspection

The requirements of the Board are subject to revision, and the continuance of a firm's Approval Authority is conditional upon compliance with current requirements and upon efficient standards of inspection being maintained.

At intervals the Board's Surveyors will visit approved firms for the purpose of rendering to the Board's Headquarters a report on the operation of the inspection organisation. The Surveyors will advise the management of their presence in the works, and, in the company of the Chief Inspector, will carry out a check inspection. The Surveyors must be afforded every facility and have access to all inspection reports and records as are necessary to enable them to complete their reports.

V

GENERAL REQUIREMENTS FOR DESIGN APPROVAL

Meaning of "Approval"

The design organisation of a firm is approved to furnish reports that the design of an aircraft complies with the Board's requirements. In principle, the same system of approval applies to the design of components, propellers, instruments, equipment and accessories and radio apparatus. Where the general principles are equally applicable no distinction is drawn in this Handbook between the different classes of design.

The significance of the phrase "to furnish reports . . ." is that when the Board is satisfied with the technical competence and the integrity of a design organisation it is willing to accept the statement of the official responsible for the design organisation that the Board's requirements have been met, without attempting to confirm in detail, from its own knowledge, the accuracy of the statement.

In other words, while the Board takes the whole responsibility for prescribing the requirements, the constructor in large measure carries the responsibility for ensuring compliance with the requirements.

This procedure has considerable advantages. It releases the design organisation from the need to submit voluminous calculations for checking by the Board's Surveyors, and tests can proceed without the Board's Surveyors being present. The Board, of course, would exercise the right to check any points of doubt and to witness important tests but there need be no delay in the procedure leading to the formal approval of the particular design. Under a properly arranged scheme of approved design organisation there is much economy in man-power.

It should, however, be appreciated that in order to obtain the full advantages of approval, the design organisation must comply with the general requirements for procedure as laid down by the

Board. These requirements have been devised to ensure that, *inter alia*, the Board is kept informed, at the appropriate times, of the stages reached in the process of design. The "paper work" has been kept to a minimum, but what there is must be adhered to in order to avoid delay.

Qualifications for Approval

Basically the qualifications for approval are that the design organisation must be sufficiently competent technically to undertake the work covered by the terms of approval, must be familiar with the Board's requirements and procedures, and must be of high moral integrity. British Civil Airworthiness Requirements give in more detail the necessary qualifications for various types of organisation.

In all cases it is necessary that the organisation of the design department both internally, and in relation to other departments, is such as to ensure that the reports furnished by the head of the design organisation are correct statements. The senior staff of the design organisation must be of a technical level adequate for the conduct of the particular kind of design involved, both in respect of establishing compliance with the Board's requirements and in the exercise of sound engineering judgment.

Where calculations are involved in showing compliance with requirements, arrangements for independent checks for accuracy of arithmetic and validity of assumptions are to be made within the organisation.

So far as test facilities are concerned, no hard and fast rule is possible, but the principle is that absence of test facilities must not be an embarrassment in establishing compliance with the requirements. For example, if a firm is able to make an arrangement with an approved test house or laboratory to undertake test work, it need not provide the test apparatus itself. In general, however, it is essential for a firm designing aircraft to have its own facilities for flight testing and weighing, and minor structural testing. For firms specialising in various kinds of equipment and components the test apparatus appropriate to the particular class of design is necessary.

Design organisations dealing with Radio and associated equipment are approved by the Board, but in this case the organisation furnishes reports to the Ministry of Transport and Civil Aviation. In other words, although the Board is only partially responsible for

the Radio requirements and for the procedure for establishing compliance with them, the Board's machinery for approving the organisation is employed.

A special kind of approval applies to organisations which, although unable to qualify for full design approval, are capable of undertaking the modification and repair of aircraft where the work involved does not affect the primary structure, handling, performance or structural strength, and where a Design Certificate from a fully approved organisation is scarcely justified by the nature and extent of such work.

VI

APPLICATION FOR AND MANNER OF GRANTING DESIGN APPROVAL

A design organisation seeking approval should first obtain the appropriate application form from the Secretary, Air Registration Board, Chancery House, Chancery Lane, London, W.C.2, which, when completed, should be forwarded to the above address. This form should be accompanied by a chart showing the responsibilities of the chief members of the organisation, together with particulars of their qualifications.

It should be noted that, under the provisions of the Air Navigation Order 1954, a statutory fee of £10 per annum is payable in respect of each approved organisation of a firm. Details of this fee are given in Schedule III of the Air Navigation Order 1954.

On receipt of the application form, arrangements will be made for the Board's Surveyors to visit the design organisation concerned, with a view to investigating and reporting on the personnel, equipment, etc. It may be that in certain respects minor improvements could be effected which would facilitate the grant of approval, in which case the Surveyor will tender advice.

The detailed terms of approval will be discussed with the applicant.

The application form specifies the following categories :—

1. The Design, excluding the design of engines, instruments, equipment, and accessories and propellers, of
   (a) landplanes
   (b) seaplanes
   (c) rotorcraft
   (d) gliders
2. The Design of components.
3. The Design of engines.
4. The Design of instruments.
5. The Design of equipment and accessories.
6. The Design of propellers.

The terms of approval granted will define the categories for which the organisation is approved, with any necessary limitations. For example, approval of a firm whose staff is familiar only with the design of single-engined landplanes might be limited to that class of work. Similarly, in instrument and equipment firms, the approval will define the particular kinds of instruments and equipment concerned. It is not usual to extend the approval beyond the immediate needs of the organisation concerned, but the terms can always be extended at short notice provided the qualifications of the firm are suitable. Needless to say, a design organisation can be approved in more than one category.

A further word can be said in explanation of the above categories. (a) Category 1, which includes the design of landplanes, seaplanes, rotorcraft and gliders, covers the design of aircraft as a whole, including the *installation* of the engine, equipment and instruments, accessories, and propellers, but it excludes the *design* of these last mentioned specialised items. (b) Components mean such items as landing gear, hydraulic systems, or complete units such as tailplanes, which are primarily intended for application to one particular type of aircraft, and which could not readily be covered by a specification but would need to be linked with the design of the type of aircraft for which they were intended. (c) Equipment and accessories, on the other hand, covers such items as wheels, tyres, landing lights, generators, accumulators, which could be used on a variety of types of aircraft and for which a general specification can be prepared. Similarly instruments are items of equipment, which record or indicate information.

If the report prepared by the Board's Surveyors after investigation is considered satisfactory by the Council of the Board, approval is granted. The Board will send a formal letter prescribing the terms of approval, which normally takes effect from the date of the letter. A schedule of the terms of approval specifying precisely the nature of the work which the firm is authorised to certify by virtue of the approval granted, will accompany the letter and a Certificate of Approval will follow in due course.

VII

OPERATION OF DESIGN APPROVAL

In addition to the technical procedure aspects of operation of approval, dealt with in this Section, the firm is required to notify the Board of any material changes of personnel or of the character of the work being undertaken, which may influence the terms of approval. At intervals the Board will, either during the course of a supervisory visit, or by letter, seek information on such matters.

The primary responsibility for operating the approval is vested in the Chief of the Design Organisation. It is his signature over which reports are to be furnished to the Board, and it is his responsibility to ensure that the organisation is such that he has every confidence in the accuracy and validity of his reports.

Frequent reference has been made to familiarity with the Board's published Requirements. This can only be achieved by a study of them, as given in British Civil Airworthiness Requirements. Some of the technical procedure aspects are summarised below.

Prototype Aircraft

As soon as it is decided that a certificate of airworthiness will be required, application should be made to the Board on the appropriate form. The earlier this application is made the more satisfactory the results will be as it enables the Board's Surveyors to offer advice regarding the interpretation of the requirements as applied to the type and to give early warning of any possible additional requirements (usually very few in number) which may be

applied. Throughout the design procedure it rests with the design organisation to seek advice on the interpretation of the requirements and to notify the Board of any intention to conduct any major tests in sufficient time to permit the tests to be witnessed, if necessary.

After receiving the application for a certificate of airworthiness, the Board's Surveyors will make periodic visits. Drawings, calculations, test reports, etc., should be available for examination, as requested. All such information should be retained during the service life of the aircraft, and drawings should be adequately identified to ensure that they can be related to the aircraft to which they refer.

Before conducting flight tests to establish compliance with the requirements, the proposed schedule of tests should be submitted to the Board for approval. After these tests have been made flight test reports should be forwarded to the Board. The Board will then decide what "official" flight tests are necessary to check the applicant's tests. The official tests may be conducted at the applicant's aerodrome by the Board's pilots, or the Board may require the aircraft to undergo tests at a suitable flight test establishment. In either case the aircraft must be properly equipped with suitable measuring and recording instruments, and the designer should discuss the proposed instrumentation at an *early* stage.

After completion of all calculations and tests, the Chief of the Design Organisation will be required to submit to the Board a signed statement that the aircraft complies with certain requirements together with a list of the exceptions which may have been accepted by the Board. This certificate is an essential feature of the approval scheme as it is the indication of the responsibility for the design, carried by the design organisation. No recommendation for a certificate of airworthiness can be made in the absence of such a certificate from the Chief of the Design Organisation. This certificate is reinforced by the Type Record, which summarises the tests and calculations made, and lists the drawings in sufficient detail to identify the aircraft. The Board may recommend the issue of a certificate of airworthiness before the Type Record is complete in all its details, but the Board must be satisfied that the essential features are complete and that the whole Record will be available within a reasonable time.

The designer is also required to provide information for inclusion in the Flight Manual and to prepare the Service and Instruction

Manual. As these contain the information essential to the safe operation and maintenance of the aircraft, it is necessary that they should be available before the aircraft is handed to an operator.

To recapitulate, the essential documents are :—

Application for the certificate of airworthiness	— early in design stages.
Proposed flight test instruments	— early in construction stages.
Flight test reports	— before the Board's official flight tests.
Design certificate	— before the Board recommends the issue of a certificate of airworthiness.
Manuals	— before aircraft is handed to operator.
Type Record	— essential particulars, including list of drawings before the Board recommends the issue of a certificate of airworthiness ; remainder within a reasonable period.

MODIFICATIONS

The written approval of the Board must be obtained for a modification which has not been previously investigated and approved. At an early stage of the design of the modification, brief particulars must be furnished to the Board, so that the modification may be classified as "minor" or "major" according to the nature and extent of the Board's investigation in connection with approval. At all times the proposed modification must be such that the design of the aircraft, when modified, satisfies the requirements that were in force at the time the aircraft type was originally certificated, or such other requirements as the Board may notify with respect to the aircraft design.

So far as the design clearance is concerned, the minor modification procedure is confined to the issue of a statement by the Board that the modification may be classified as minor.

The major modification procedure is basically the same as that for a prototype aircraft, but the procedure is adjusted according to the kind of modification. The need for and extent of flight tests will depend on the kind of modification ; a Design Certificate must always be submitted, and an addendum to the Type Record is usually necessary.

Components

The procedure, both as regards prototype components and modifications to components, is basically the same as in the case of complete aircraft. The component may, however, be designed and manufactured by a firm other than the firm building the aircraft. In this case the responsibility is divided between the two firms. The fundamental principle is that the firm designing the complete aircraft must be responsible for deciding whether the component is suitable for incorporation in the aircraft, and the component firm must make available all information to the aircraft firm to facilitate this decision.

In the case of a component designed for use on only one type of aircraft, the component designer need not make application for approval of the component, as the aircraft firm's application for a certificate of airworthiness covers all such incorporated components. The component firm must supply the aircraft firm with a component Type Record, and if necessary material for inclusion in the Manuals. Similarly when a component is built into one type of aircraft only an application for approval of the modification can be made by the aircraft firm, after consultation with the component firm.

If, however, the component designer intends a component for use on several types of aircraft, it may be convenient to approve the component as an accessory.

Propellers

The designer should first apply for approval on the appropriate form, and should submit a schedule of proposed tests. The "Type Record" consists of a schedule of parts and a report of the tests and calculations. The Service and Instruction Manual should be available before the propeller is used in service, and the propeller designer should make available any information necessary for inclusion in the Flight Manual.

Instruments, Equipment and Accessories

As previously mentioned, instruments, equipment and accessories, are items for which a specification can be prepared, and which are often suitable for use in a variety of aircraft. The Board may publish its own specifications, or may accept specifications prepared by other bodies or by the designer. In the latter event, the designer should apply to the Board for approval of the proposed specifi-

cation. This specification should include particulars of any tests or procedures to which the item will be submitted to ensure reliability and accuracy. The Board, if satisfied, will signify its approval of the specification by formal letter. It is then the responsibility of the Organisation designing the accessory to certify that the accessory complies with the approved specification. The Board will then, if satisfied, allot an approval reference number prefixed by the letter "E," which indicates that the accessory has been approved. It is a condition of approval that the designer should prepare Service and Instruction Manuals and make them available before the item is used in service. Where the satisfactory operation of the item is affected by the external conditions (e.g., climatic conditions, altitude, vibration and accelerations), or by any special installation requirements, the designer should make clear in a statement to the aircraft designer any necessary limitations on the use of the item. Usually the item will only be approved for those uses for which it has been shown, by tests or otherwise, to be suitable.

Modifications to instruments, items of equipment and accessories may affect their approval, and design organisations must immediately notify the Board of improvements or modifications which affect airworthiness or where a new "Mark" is introduced. Where applicable, the Board's modification procedure must be followed.